

200AS1

# ICEpower200AS1

One Channel 200 W ICEpower Amplifier with Integrated Universal Mains Power Supply

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# 1 General Description

ICEpower200AS1 is a fully integrated audio power amplifier module including universal mains ErP and Energy Star compliant power supply. ICEpower200AS1 is a one-channel module.

ICEpower200AS1 provides comprehensive protection and monitoring functions with an easy-to-use control interface.

ICEpower200AS1 is designed for very high continuous output power, making it ideal for applications requiring sustaining output power in e.g. bass and guitar amplifier applications.

The integrated aluminum base plate on the 200AS1 acts as both cooling and mechanical interface. This enables easy integration and extra cooling can be added.

ICEpower200AS1 is EMC and safety pre-approved enabling fast design-in and minimum time to market.

Features	Benefits
Fully integrated amplifier	No need for additional circuits for simple applications
Short circuit and over-current protection	Ensures reliable and robust end-products
Comprehensive monitoring and protection	Keeps track of module operation and protects the module from overload
Clip monitor and thermal warning outputs	Allows the end-product system to react proactively, preventing system shutdown and enabling "Music at All Times"
Protect status output	Indicator for module protection shutdown
Auxiliary power supply output	Supply for analog and control circuits in e.g. a signal front-end and standby supply
Standby mode	ErP (1275/2008/EC) and Energy Star® v3.0 compliant
Universal mains	No need for region specific variants
EMC and safety pre-approved	Suitable for CE and FCC approved designs
Simple yet flexible mechanical mounting	Easy mechanical integration and thermal management
ICEpower standard connector and pin definition	Allows reuse of front-end hardware
Low build height	Usable in 1U rack enclosures
Prepared for hanger amplifier modules	Extra audio channels for e.g. 3-way active speakers

## 1.1 Key Specifications

- 1 x 200 W / 4 Ω @ 1 % THD+N, 1 kHz
- 0.003 % THD+N @ 1 kHz, 10 W / 4 Ω
- 30 kHz audio bandwidth
- < 92 uV A-weighted output noise
- Minimum load impedance at 2.7 Ω
- Maximum output voltage / current: 41 V<sub>p</sub> / 24 A<sub>p</sub>
- +8 V<sub>DC</sub> and +/-17 V<sub>DC</sub> auxiliary supply outputs
- Universal mains (100 – 240 V, 50 – 60 Hz)
- Size (L x W x H): 140 mm x 77 mm x 36.5 mm (5.51 inch x 3.03 inch x 1.44 inch)

## 2 Document History

Version	Date	Revised by	Changes
1.0	2018-09-11	MGA/DIT	Release version
1.1	2018-10-12	LBH/DIT	Chapter 8 Electrical Specifications and 10 Typical Performance Characteristics updated
1.2	2018-11-05	LBH/DIT	Absolute Maximum Ratings updated
1.3	2018-12-17	DIT	Redesign of datasheet

### 3 Getting Started

ICEpower200AS1 is a fully self-contained amplifier module and requires no interaction nor control to operate.

For first time use, please connect an audio source to the analog input and loudspeakers to the speaker output connector before applying power to the AC mains input. ICEpower200AS1 will start operating right after mains is applied.

### 4 Block Diagram

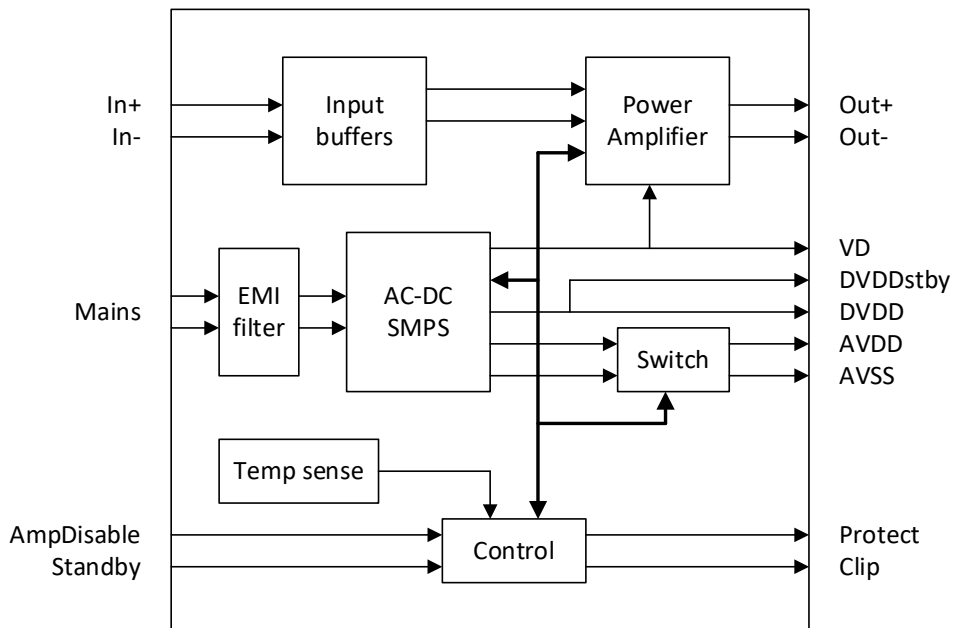


Figure 1: ICEpower200AS1 block diagram

# 5 Connectors

ICEpower200AS1 comes with industry standard connectors, selected for long-term reliability.

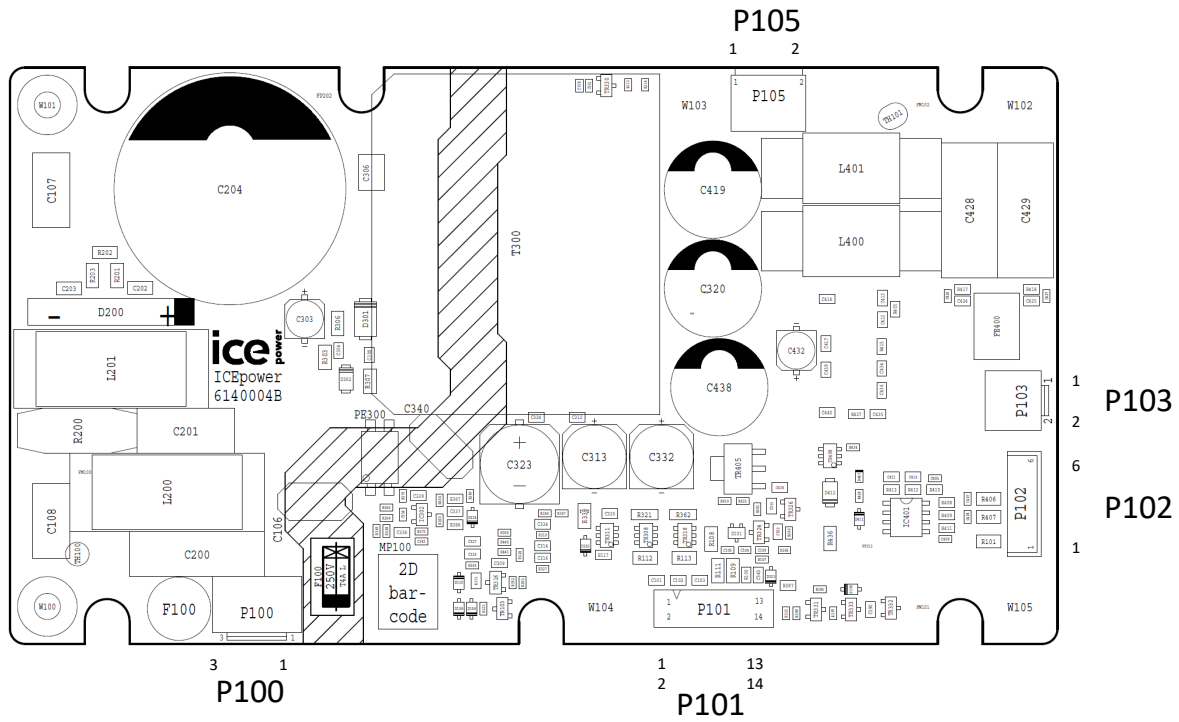


Figure 2: ICEpower200AS1 connector overview

## 5.1 P100: AC Mains Connector

Type: JST, B2P3-VH (LF)(SN)			
PIN	Function	Description	Type
1	Neutral	Neutral AC	Mains input
2	NA	Pin Not Available	
3	Live	Live AC	Mains input

Table 1: Mains Connector

## 5.2 P101: Basic Control Connector

Type: JST, B14B-PHDSS (LF)(SN)				
PIN	Function	Description	Type	Reference
1	DVDD	Control auxiliary voltage	Power output	GND
2	GND	Auxiliary ground	GND	
3	DVDDstby	Control auxiliary standby voltage	Power output	GND
4	GND	Auxiliary ground	GND	
5	AVDD	Positive analog auxiliary voltage	Power output	GND
6	Standby	Module standby	Control input, active high	GND
7	AVSS	Negative analog auxiliary voltage	Power output	GND
8	Reserved	Not connected		
9	Clip	Voltage clip indicator	Status output, open collector, active low	GND
10	AmpDisable	Disable amplifier (mute)	Control input, active high	GND
11	Reserved	Not connected		
12	Protect	Module protection indicator	Status output open collector, active low	GND
13	Reserved	Not connected		
14	GND	Auxiliary ground	GND	

Table 2: Basic Features Connector

## 5.3 P102: Audio Input Connector

Type: JST, B6B-PH-K-S (LF)(SN)				
PIN	Function	Description	Type	Reference
1	InShield	Signal shield	Analog audio input shield	Resistor to GND
2	In+	Non-inverting input signal	Analog audio input	GND
3	In-	Inverting input signal	Analog audio input	GND
4	Reserved	Not connected		
5	Reserved	Not connected		
6	Reserved	Not connected		

Table 3: Audio Input Connector

## 5.4 P103: Loudspeaker Output Connector

Type: JST, B2P-VH (LF)(SN)			
PIN	Function	Description	Type
1	Out+	Non-inverting output signal	Audio power output
2	Out-	Inverting output signal	Audio power output

Table 4: Loudspeaker Output Connector

## 5.5 P105: Hanger Rail Supply Connector

Type: JST, B02P-NV (LF)(SN)				
PIN	Function	Description	Type	Reference
1	VD	Positive amplifier DC rail voltage	Power output (Note 1)	GND
2	GND	Ground	GND	

Table 5: Hanger Rail Supply Connector

Note 1: As specified in Section 10.5, a 1.6 A fast acting fuse MUST be included in the supply line on an optional amplifier module connected to the Hanger Rail Supply connector.



## 6 Absolute Maximum Rating

Symbol	Parameter	Min	Max	Units
$V_{ac}$	Mains input voltage (safety test)	85 (Note 2)	264 (Note 2)	$V_{RMS}$
$f_{mains}$	Mains frequency	45	65	Hz
$V_{audio}$	Audio inputs voltage relative to GND (DC+AC)	-8	8	V
$V_{control}$	Control inputs voltage	GND - 0.7	25	V
$V_{status}$	Status output external pull up voltage	GND - 0.7	DVDD + 0.7	V
$I_{status}$	Status output sink current	0	20	mA

Table 6: Absolut maximum ratings

Note 2: The maximum operating/usage mains voltage is 240Vac and the minimum operating/usage mains voltage is 100Vac.

## 7 Electrical Specifications

Unless otherwise specified:

- $T_a = 25\text{ °C}$ ,  $f = 1\text{ kHz}$ ,  $R_L = 4\ \Omega$ , 230 Vac / 50 Hz mains, AES17 measurement filter and AP AUX-0025 filter,
- Module mounted centered on a 2 mm x 200 mm x 300 mm aluminum plate.

### 7.1 Audio

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$P_o$	Output power	$f_{in} = 1\text{ kHz}$ , THD+N = 1 %, $R_L = 4\ \Omega$ 230 V <sub>ac</sub> / 50 Hz 120 V <sub>ac</sub> / 60 Hz 100 V <sub>ac</sub> / 50 Hz		210 210 210		W
$P_o$	Output power	$f_{in} = 1\text{ kHz}$ , THD+N = 10 %, $R_L = 4\ \Omega$ 230 V <sub>ac</sub> / 50 Hz 120 V <sub>ac</sub> / 60 Hz		255 255		W
$P_o$	Output power	$f_{in} = 1\text{ kHz}$ , THD+N = 1 %, $R_L = 8\ \Omega$ 230 V <sub>ac</sub> / 50 Hz 120 V <sub>ac</sub> / 60 Hz		117 117		W
$t_{pmax}$	Duration of power burst at full power	$f_{in} = 1\text{ kHz}$ , $P_o = 200\text{ W} / 4\ \Omega$ 230 V <sub>ac</sub> / 50 Hz 120 V <sub>ac</sub> / 60 Hz		800 800		s
$P_{o-con}$	Continuous output power without thermal shutdown	$f_{in} = 1\text{ kHz}$ , THD+N = 1 %, $R_L = 4\ \Omega$ 230 V <sub>ac</sub> / 50 Hz 120 V <sub>ac</sub> / 60 Hz		130 140		W
$V_{o-max}$	Maximum output voltage			41		V <sub>p</sub>
$I_{o-max}$	Maximum output current	(Output current limited)		24		A <sub>p</sub>
THD+N	Total harmonic distortion + noise	$f_{in} = 1\text{ kHz}$ , $P_o = 10\text{ W} / 4\ \Omega$		0.003		%
N	Output noise	20 Hz – 20 kHz, un-weighted 20 Hz – 20 kHz, A-weighted		126 92		$\mu\text{V}$
DNR	Dynamic range	20 Hz – 20 kHz, un-weighted 20 Hz – 20 kHz, A-weighted		107 110		dB

IMD <sub>3</sub>	3 <sup>rd</sup> order intermodulation	18 kHz + 19 kHz, each -10dB relative to 200 W / 4 Ω		-66		dB
	Idle tones	V <sub>in</sub> = 0 V, 0 dB = 200 W / 4 Ω		-135		dB
V <sub>in</sub>	Input sensitivity	f <sub>in</sub> = 1 kHz, P <sub>o</sub> = 200 W / 4 Ω		2.5		V <sub>p</sub>
A <sub>v</sub>	Voltage gain	f <sub>in</sub> = 1 kHz		24		dB
f	Frequency response	f <sub>in</sub> = 20 Hz - 20 kHz, R <sub>L</sub> = 4 - 8 Ω		+/-1		dB
f <sub>U</sub>	Upper bandwidth (-3dB)	R <sub>L</sub> = 4 Ω, no measurement filters		50		kHz
f <sub>L</sub>	Lower bandwidth (-3dB)	R <sub>L</sub> = all loads		3		Hz
f <sub>U-power</sub>	Upper bandwidth at nominal power	R <sub>L</sub> = 4 Ω, P <sub>o</sub> = 200 W / 4 Ω, no measurement filters		25		kHz
f <sub>L-power</sub>	Lower bandwidth at nominal power	R <sub>L</sub> = 4 Ω, P <sub>o</sub> = 200 W / 4 Ω, no measurement filters		20		Hz
Z <sub>o</sub>	Output impedance	f <sub>in</sub> = 1 kHz		200		mΩ
R <sub>load</sub>	Load impedance		2.7			Ω
C <sub>load</sub>	Capacitive load				100	nF
Z <sub>in-signal</sub>	Input impedance signal lines	Semi-balanced input configuration, Non-inverting input Inverting input		3.0 1.8		kΩ
Z <sub>in-GND</sub>	Audio input shield to GND impedance			22		Ω
V <sub>clamp</sub>	Audio input clamp voltage			3		V
V <sub>in_CMR</sub>	Input common mode range		-3		3	V
V <sub>o-offset</sub>	Speaker output DC common mode offset			23		V
f <sub>PWM</sub>	Amplifier power stage switching frequency			450		kHz

Table 7: Audio performance

## 7.2 Control and Status

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>control</sub>	Control input voltage range		0		DVDD	V
V <sub>control_low</sub>	Control input low signal				0.8	V
V <sub>control_high</sub>	Control input high signal		2.5			V
Z <sub>control</sub>	Control input impedance	Internal pull down		50		kΩ
V <sub>status</sub>	Status output voltage range	Open collector, external pull up	0		DVDD	V
V <sub>status_low</sub>	Status output low	I <sub>out</sub> = 1mA		0.5		V
I <sub>status</sub>	Status output sink current		0		20	mA
Z <sub>status</sub>	Status output series impedance			240		Ω
T <sub>Amp-OT-warning</sub>	Amplifier temperature warning			125		°C
T <sub>Amp-OT-limit</sub>	Amplifier over temperature limit			150		°C
T <sub>Amp-OT-reset</sub>	Amplifier over temperature reset			120		°C

Table 8: Control and Status specifications

## 7.3 Timing

For detailed description of the below listed timing values, please consult Section 10 of this datasheet.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{\text{Mains-Audio-set}}$	Mains input – audio output delay	$P_o = 200W / 4 \Omega$		500		ms
$t_{\text{Mains-Audio-hold}}$	Mains input – audio output hold time	$1/8 P_o$ into $4 \Omega$ , no aux load		200		ms
$t_{\text{Mains-Aux-set}}$	Mains input – aux supply delay	$1/8 P_o$ into $4 \Omega$ , no aux load		50		ms
$t_{\text{Mains-Aux-hold}}$	Mains input – aux supply hold time	$1/8 P_o$ into $4 \Omega$ , no aux load		200		ms
$t_{\text{Stby-Audio-set}}$	Standby mode set delay			5		ms
$t_{\text{Stby-Audio-release}}$	Standby mode release delay	$P_o = 200W / 4 \Omega$		500		ms
$t_{\text{Stby-AVDD-AVSS-hold}}$	Standby mode AVDD/AVSS hold time	No aux load		2		ms
$t_{\text{Stby-AVDD-AVSS-release}}$	Standby mode AVDD/AVSS release time	No aux load		1		ms
$t_{\text{Stby-Idvdd-delay}}$	Standby mode – $I_{\text{DVDD}}$ delay			500		ms
$t_{\text{AmpDis-Audio-set}}$	AmpDisable set delay			10		ms
$t_{\text{AmpDis-Audio-release}}$	AmpDisable release delay			200		ms
$t_{\text{Aux-OC-detect}}$	Aux OC detect delay			10		ms
$t_{\text{Aux-OC-recovery}}$	Aux OC recovery delay			5		s
$t_{\text{Amp-OC-detect}}$	Amplifier OC detect delay			15		ms
$t_{\text{Amp-OC-recovery}}$	Amplifier OC recovery delay			3		s
$t_{\text{Amp-OT-recovery}}$	Amplifier OT recovery delay			1		s

Table 9: Timing specifications

## 7.4 Power Supply

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$V_{\text{DVDD}}$	Control aux supply output voltage	$P_{\text{out\_audio}} = 200 W$ , no aux load Idle and $I_{\text{DVDD}} = 0.7 A$ Amp disabled and $I_{\text{DVDD}} = 0.7A$	6.5	10.2 7.1 6.9	11	V
$I_{\text{DVDD}}$	Control aux supply output current	Normal operation			700	mA
$I_{\text{DVDD}}$	Control aux supply output current	Standby-mode			20	mA
$I_{\text{DVDD\_prot}}$	Control aux current protection limit			1		A
$C_{\text{DVDD}}$	DVDD external decoupling capacitor				470	$\mu\text{F}$
$V_{\text{AVDD}}$	Positive analog auxiliary supply output voltage	$P_{\text{out\_audio}} = 200 W$ , no aux load Idle and $I_{\text{AVDD}} = 0.15A$		20.5 16.3		V
$I_{\text{AVDD}}$	Positive analog auxiliary supply output current				150	mA
$I_{\text{AVDD\_prot}}$	Positive analog aux current protection limit			250		mA
$C_{\text{AVDD}}$	AVDD external decoupling capacitor				33	$\mu\text{F}$
$V_{\text{AVSS}}$	Negative analog auxiliary supply output voltage	$P_{\text{out\_audio}} = 200 W$ , no aux load Idle and $I_{\text{AVDD}} = 0.15A$		-20.5 -16.3		V

$I_{AVSS}$	Negative analog auxiliary supply output current				-150	mA
$I_{AVSS\_prot}$	Negative analog aux current protection limit				-250	mA
$C_{AVSS}$	AVSS external decoupling capacitor				33	$\mu$ F
$V_{VD}$	Positive hanger supply output voltage	$P_{out\_audio} = 200\text{ W}$ , no aux load Idle and $I_{DVDD} = 0.7\text{ A}$			45 47	V
$I_{VD}$	Positive hanger supply output current (Note 3)	Output NOT over-current protected			0.8	$A_{rms}$
$C_{VD}$	VD external decoupling capacitor				560	$\mu$ F
$P_{idle}$	Module idle consumption, amp enabled	$P_{aux} = 0\text{ W}$			6.7	W
$P_{amp\_disabled}$	Module idle consumption, amp disabled	$P_{aux} = 0\text{ W}$			4.3	W
$P_{standby}$	Module standby consumption	230 $V_{ac}$ / 50 Hz, $I_{DVDD} = 0\text{ mA}$ 120 $V_{ac}$ / 60 Hz, $I_{DVDD} = 0\text{ mA}$			250 240	mW
$P_{mains}$	Mains power	$P_{out\_audio} = 25\text{ W}$ , $I_{DVDD} = 0.7\text{ A}$ Idle and $I_{AVDD} = 0.15\text{ A}$ 120 – 230 $V_{ac}$ / 50 – 60 Hz			60	W
$\eta$	Module power efficiency	$P_{aux} = 0\text{ W}$ , $P_{out\_audio} = 200\text{ W}$			78	%

Table 10: Power supply specifications

**Note 3:** As specified in Section 10.5, a 1.6 A fast acting fuse MUST be included in the supply line on an optional amplifier module connected to the Hanger Rail Supply connector. Failing to comply with this requirement is against the ICEpower warranty policy.

# 8 Mechanical Specification

## 8.1 Dimensions

Symbol	Parameter	Condition	Min	Typ	Max	Unit
L	Module length			140		mm
W	Module width			77		mm
H	Module height				36.5	mm
Mass	Weight			310		g
H <sub>Base</sub>	Base plate thickness		1.9		2.1	mm
H <sub>M3</sub>	Mounting hole depth	M3 threads on module base plate			4.0	mm
T	Mounting torque	M3 threads on module base plate			0.5	Nm

Table 11: Mechanical dimensions

## 8.2 Mounting Holes

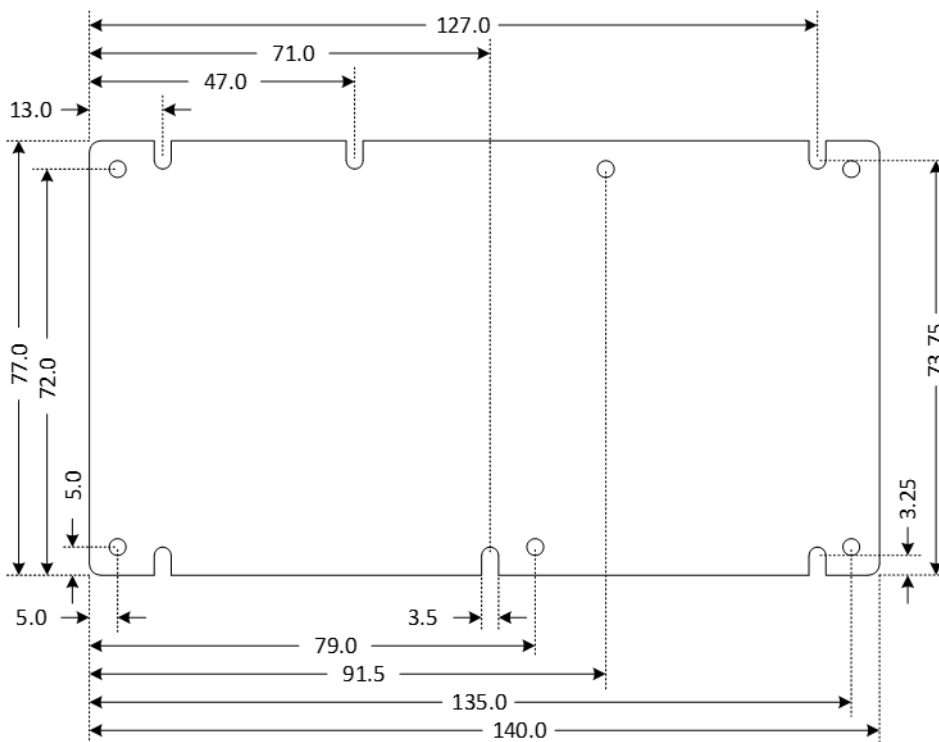


Figure 3: ICEpower200AS1 baseplate mechanical dimensions in mm seen from top side

## 8.3 Environmental Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
T <sub>operating</sub>	Ambient temperature, operating	End-customer use cases	0		50	°C
T <sub>storage</sub>	Ambient temperature, storage	End-customer use cases	-40		70	°C
T <sub>shelf</sub>	Ambient temperature, shelf	Storage before goods sold to end-customer	0		60	°C
RH	Relative humidity	Non-condensing Operating and storage			85	%
	Altitude, operating				2000	m

Table 12: Environment specifications

## 8.4 Mechanical and Environmental tests

ICEpower200AS1 has undergone extensive environmental testing including Highly Accelerated Life Test (HALT).

Test	Acceleration	Amount
Random vibration	2.1 g <sub>rms</sub> , random profile composed of 5 frequencies in the range 5 Hz to 275 Hz	3 perpendicular directions 3 x 20 min. + 3 x 10 min. + 3 x 10 min.
Shock	40 g / 26 ms to 70 g / 12 ms in steps of 10 g	6 directions, 3 shocks per direction

Table 13: Mechanical tests

To ensure overall end-product robustness, ICEpower recommends vibration test of the final product including the ICEpower200AS1 module. Excess vibration caused by e.g. insufficiently damped resonances in a mechanical chassis or extensive exposure to high sound pressure level audio from a speaker unit can damage the product.

## 9 Typical Performance Characteristics

Unless otherwise specified: Test frequency 1 kHz,  $T_a = 25\text{ }^\circ\text{C}$ , 230 V / 50 Hz mains, module mounted centered on a 2 mm x 200 mm x 300 mm aluminum plate. Audio Precision AUX0025 and AES17 20 kHz filter.

### 9.1 Frequency Response

Measurement bandwidth: 0 – 500 kHz.  $P_o = 5\text{ W} / 4\ \Omega$

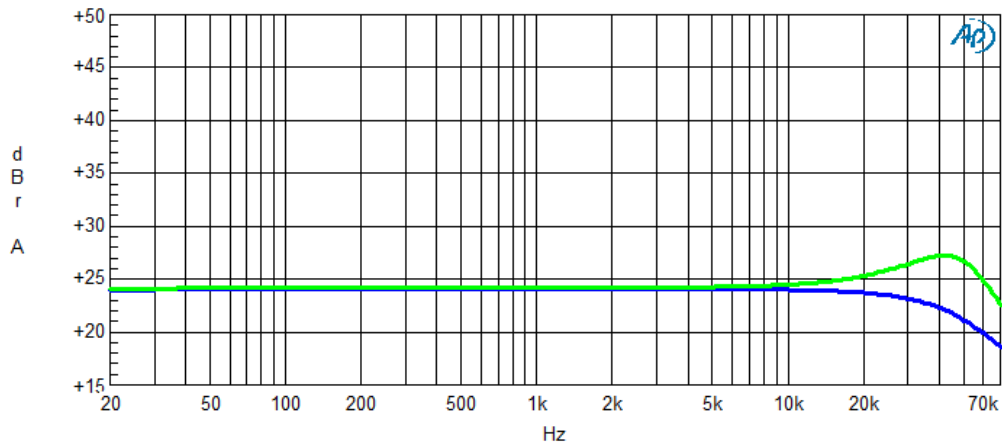


Figure 4: Amplitude vs frequency @  $R_L = 4\ \Omega$  (blue) and  $R_L = 8\ \Omega$  (green). For more details see ICEpower100AS1/100AS2/200AS1/200AS2 Application Note.

## 9.2 Total Harmonic Distortion

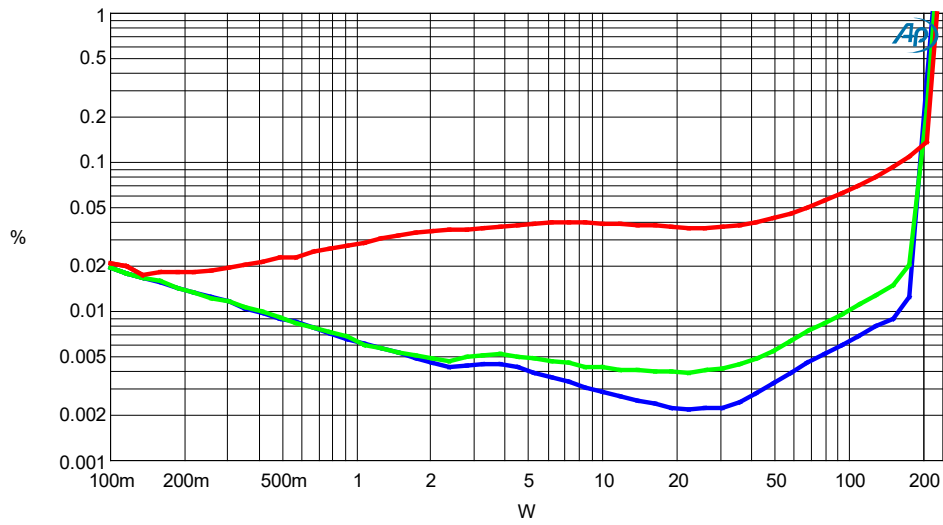


Figure 5: THD+N vs. power @ 100 Hz (blue), 1 kHz (green), 6.66 kHz (red),  $R_L = 4 \Omega$

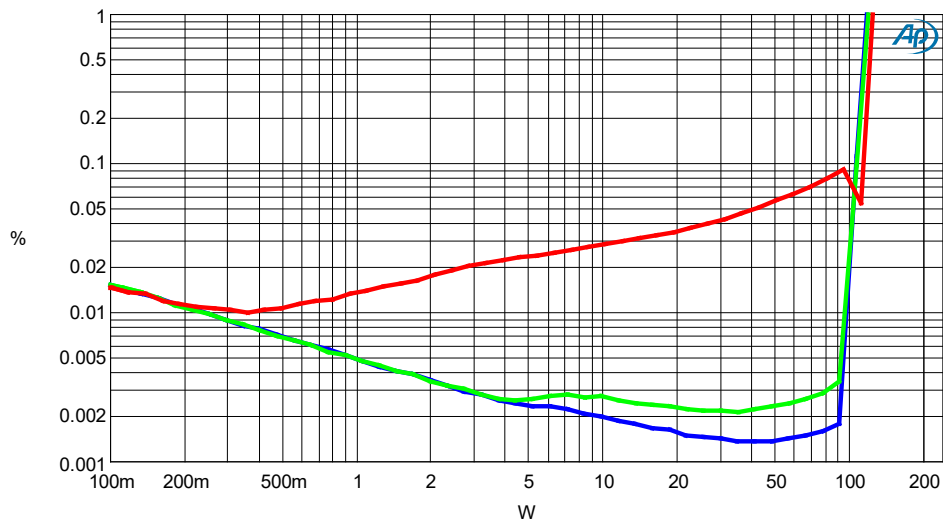


Figure 6: THD+N vs. power @ 100 Hz (blue), 1 kHz (green), 6.66 kHz (red),  $R_L = 8 \Omega$



### 9.3 Idle Noise

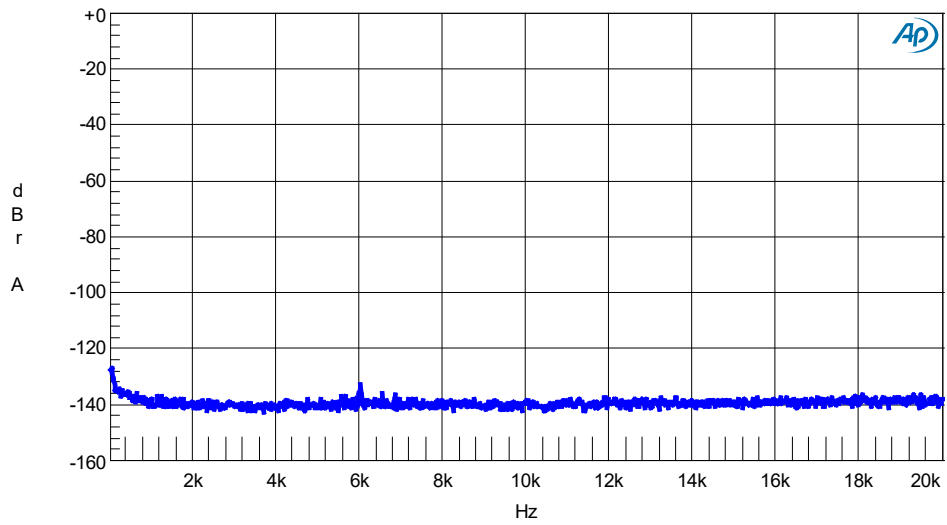


Figure 7: Idle noise spectrum, 0 - 20 kHz @ 0dB = 200 W / 4 Ω

### 9.4 Intermodulation

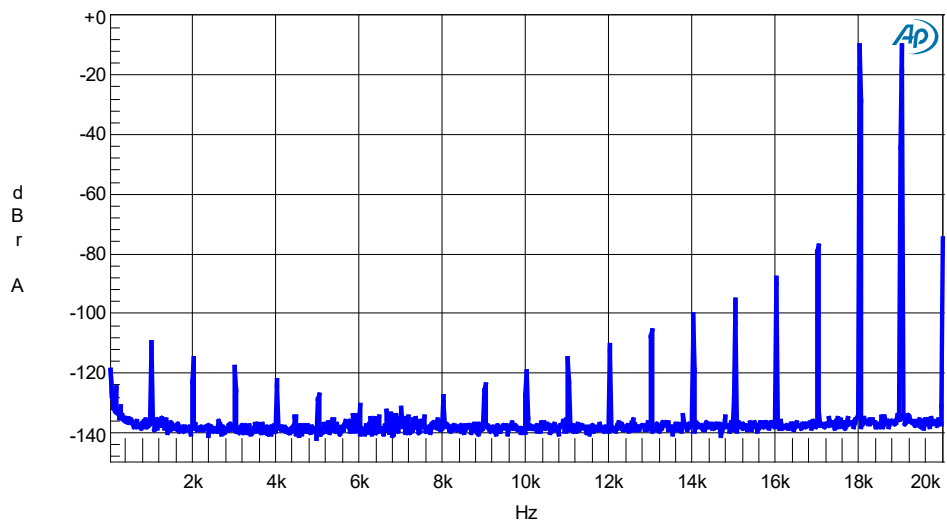


Figure 8: Dual tone intermodulation spectrum, 0 - 20 kHz @ 0 dB = 200 W / 4 Ω

## 9.5 Output Impedance

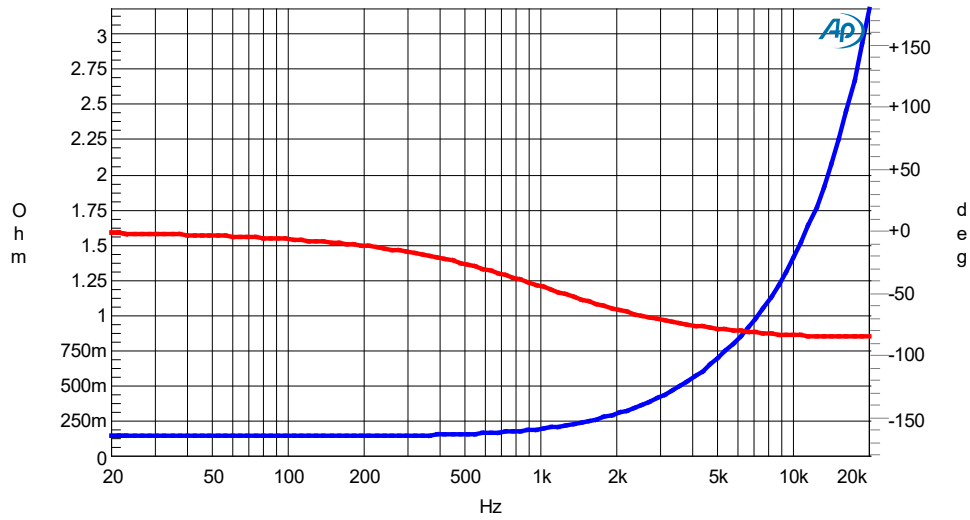


Figure 9: Output impedance vs. frequency, 20 – 20 kHz (blue), phase (red)

## 9.6 Damping Factor

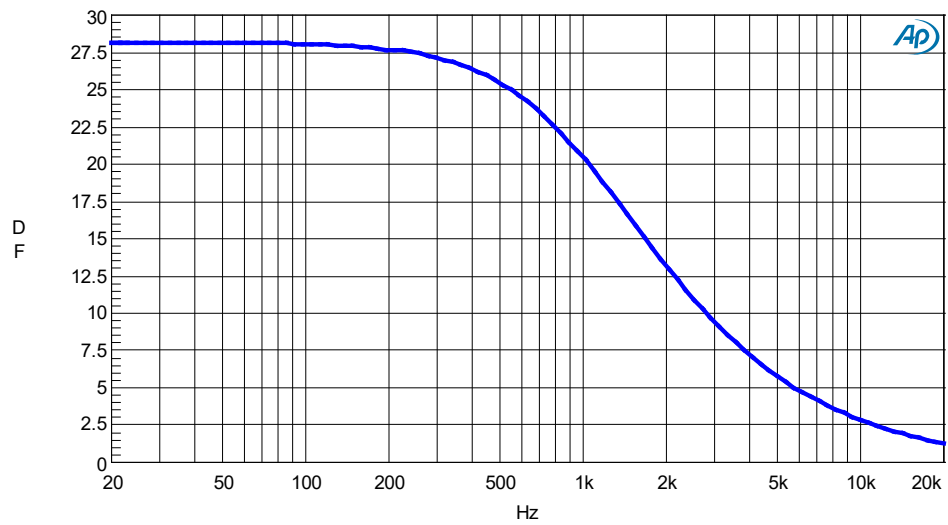


Figure 10: Damping factor vs. frequency, 20 – 20 kHz, 4 Ω (blue)

## 9.7 Output Power vs. Mains

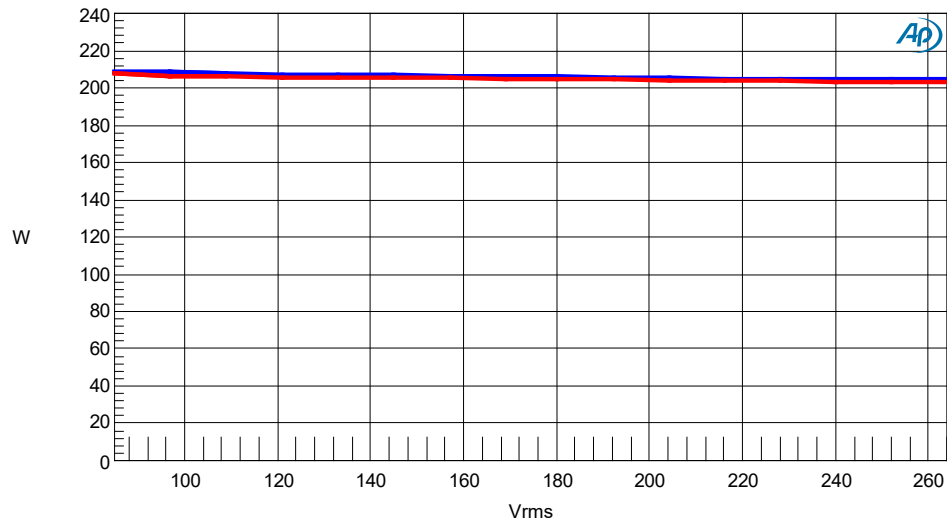


Figure 11: Output power vs. mains, mains freq. 50 Hz (blue), 60 Hz (red)

## 9.8 Power Efficiency

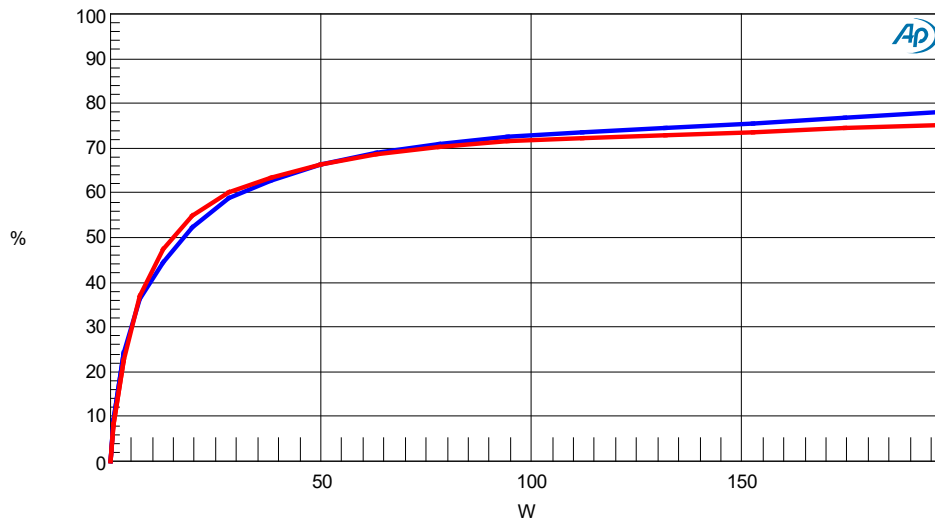


Figure 12: Power efficiency vs. output power, 230 V / 50 Hz (blue), 120 V / 60 Hz (red)

## 9.9 Dissipated Power

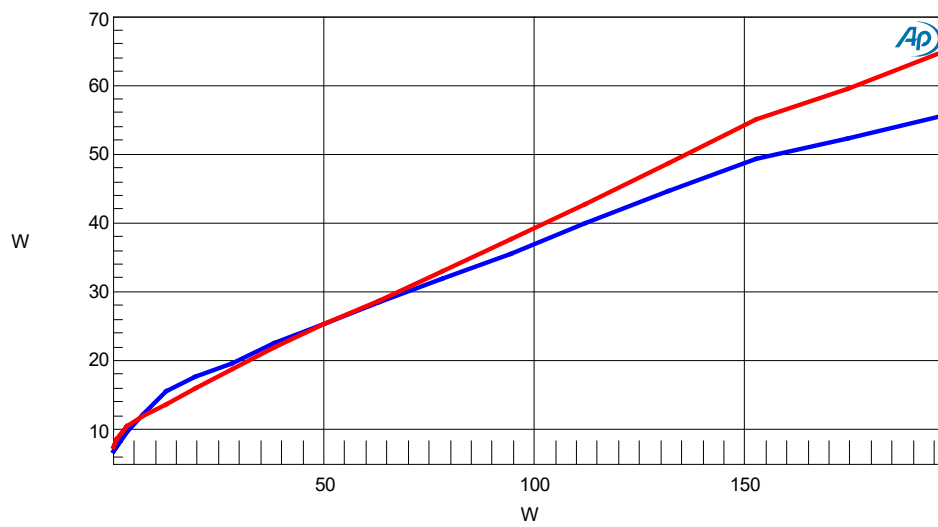


Figure 13: Dissipated power vs. output power, 230 V / 50 Hz (blue), 120 V / 60 Hz (red)

# 10 Functional Description

ICEpower200AS1 will start operating when power is applied to the module and therefore no special control is needed for simple applications. For more advanced applications, a wide set of control, status and monitoring inputs and outputs are available all through a connector following the ICEpower Standard Interface definition. Additionally, auxiliary power supply outputs are provided for signal and control front-ends as well as power for an optional hanger amplifier module.

Following ICEpower's "Music at All Times" philosophy, the module will operate under all conditions except for potentially destructive situations. At power-up, the 200AS1 module performs comprehensive checks to verify operation conditions and to check for errors. If an error is detected, the module will try to reboot after a short delay. As part of the effort to keep music playing, the module monitors numerous internal parameters during operation and reacts proactively if required.

In the following subsections, a description is given for all 200AS1 features organized per the connector in which the corresponding input or output is located.

## 10.1 Audio Input

The audio input of the 200AS1 is semi-balanced input including a non-inverting and inverting signal input and a signal ground.

The recommended use of this input is to connect the non-inverting input to a single ended signal source and use the inverting input as ground sense on the signal source reference. The signal ground should also be connected to ground on the front-end PCB.

To prevent ground loop related noise and hum problems, the signal ground is fitted with low value series resistors on the module i.e. the signal ground wire must not carry any additional current. The recommended connection to the audio input is shown on Figure 20 in Section 11.

To get best possible suppression of noise and mains related hum in the end-product, proper attention must be put into signal source output impedance in both the signal and the ground sense wires.

## 10.2 Speaker Outputs

The speaker output of the 200AS1 is a balanced output with two active signal lines capable of driving complex speaker loads. As the speaker output is already in a balanced configuration, bridging of two channels is not possible.

The speaker output is fully overload and short circuit protected. In case of an overload or short circuit event, the module will shut down and resume operation when the overload or short circuit has been removed.

Due to the single supply amplifier circuit topology, a common mode DC offset is present on the speaker outputs. It is therefore not possible to connect one of the outputs to ground. The module is protected against such an event, and the module will not start if a short to ground is detected.

## 10.3 AC Mains Input

ICEpower200AS1 has a universal mains input operating on all common mains supplies. No switching between low and high mains is required.

When power is applied to the 200AS1, the module will read the control inputs and start operating accordingly. If the module controls are left unconnected, the module will start normal operation without further action.

The power up and power down timing is shown in Figure 14 and specific timing values are available in Section 7.3.

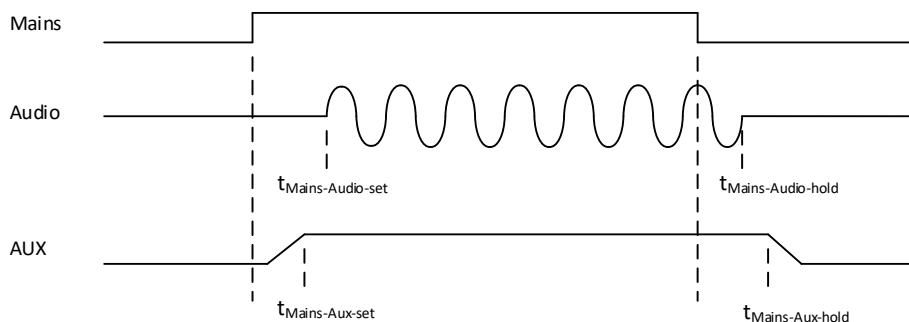


Figure 14: Power up timing

The 200AS1 is fitted with a non-replaceable fuse on the mains input. In case of a burned fuse, the module is defective and must be replaced.

## 10.4 Basic Control and Status

The Basic Control and Status connector includes auxiliary power supply outputs for e.g. a signal front-end PCB and the following features:

- Standby input
- AmpDisable input
- Clip output
- Protect output

The recommended connection to the control input and status outputs are shown on Figure 21 and Figure 22 in Section 11.

### 10.4.1 Standby Input

The Standby input brings the 200AS1 in standby mode when pulled high. An internal pull down ensures normal operation mode if the Standby input is left unconnected.

In standby mode, the amplifier section of the 200AS1 will shut down leaving only the power supply operating in a low power mode. To reduce power consumption in the overall system including an external signal front end, the positive and negative auxiliary supply outputs AVDD and AVSS are shut off while the control supply DVDD is kept running in a low power mode. In this low power mode, DVDD and DVDDstby can deliver a reduced amount of current for e.g. a front-end system microcontroller.

Timing of the Standby input is shown in Figure 15 and specific timing values are available in Section 7.3.

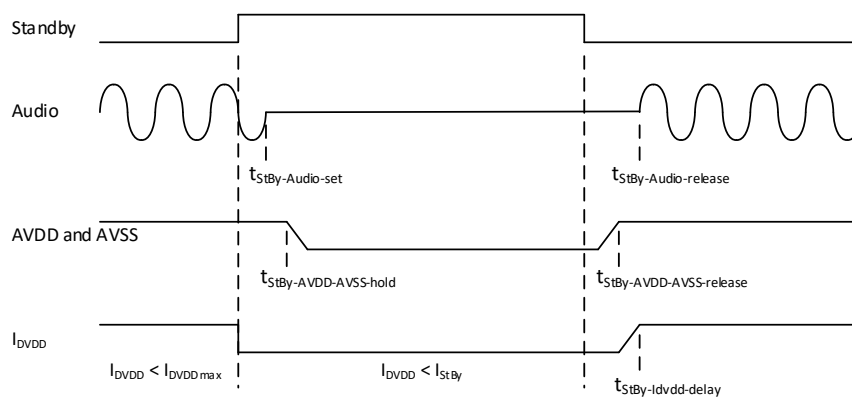


Figure 15: Standby timing on auxiliary supplies

Before bringing the 200AS1 in Standby mode, it is important to reduce the current consumption on DVDD supply output to a value below the specified maximum Standby mode current.

When changing between Standby mode and On mode a minimum period of 3 seconds is recommended before changing back to previous mode.

### 10.4.2 AmpDisable Input

The AmpDisable input shuts down the 200AS1 amplifier section when pulled high. An internal pull down ensures normal operation if the AmpDisable input is left unconnected. In AmpDisable mode, all power supplies are left running including all auxiliary supply outputs.

This feature can be used in e.g. applications where a front-end needs time to boot a DSP based systems at power up before enabling the amplifier.

Timing of the AmpDisable inputs shown in Figure 16 and specific timing values are available in Section 7.3.

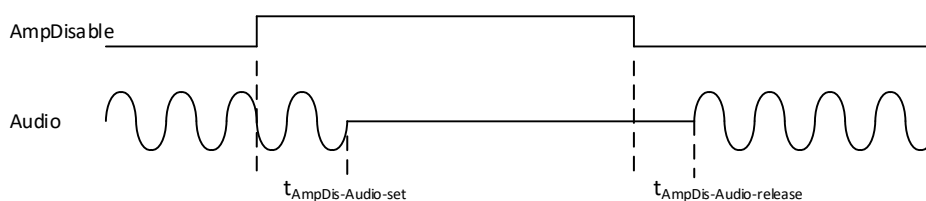


Figure 16: Standby and AmpDisable timing

Advanced pop and click reduction mechanisms are built into the 200AS1 leaving almost no audible artifacts when operating the Standby and AmpDisable inputs.

### 10.4.3 Clip Output

The Clip output is a multi-purpose output indicating:

- Audio signal voltage clipping
- Audio signal current limiting
- Power stage over-temperature warning

Voltage clipping, and current limiting events are reported as a low pulse once per PWM cycle on the Clip output.

In case of an over-temperature situation, the Clip output is pulled low continuously if the amplifier power stage is above the thermal threshold  $T_{\text{Amp-OT-warning}}$ . The Clip output is automatically released when the temperature is below the threshold again.

The Clip output is an open-collector output pulled high by external pull-up resistors. Interface schematics can be found in Section 11.3.

### 10.4.4 Protect Output

In case of potentially destructive overload situations, the 200AS1 will shut down and resume operation after a short delay or after the overload-condition has been removed. These events are reported by a low level on the Protect output.

Events that will trigger the Protect output are:

- Severe amplifier overcurrent conditions and short circuit in the amplifier section
- Overcurrent conditions on the auxiliary power supply outputs, DVDD, DVDDstby, AVDD and AVSS

- Over-temperature errors in the module

In the first two cases, the 200AS1 module will resume operation shortly after the error condition has been removed. For the over-temperature case, it is also required that the module temperature is brought below the temperature reset threshold  $T_{\text{Amp-OT-reset}}$  again.

The protection events listed above are all related to the secondary side of the 200AS1 power supply. Protection events related to the primary side of the module power supply are not reported.

The Protect output is an open-collector output pulled high by an external pull up resistor. Interface schematics can be found in Section 11.3.

Timing of the protection events are shown in Figure 17 through Figure 19 and specific timing values are available in Section 7.3.

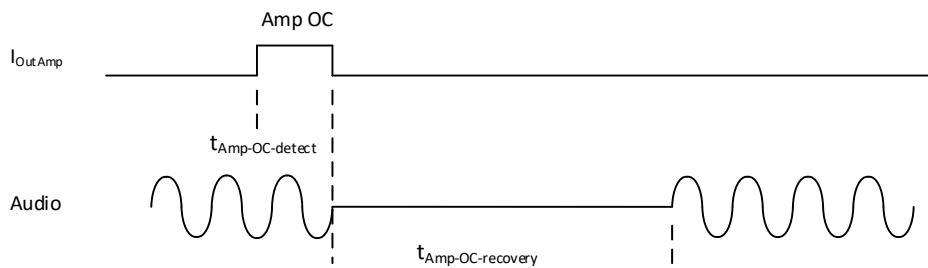


Figure 17: Speaker output overcurrent timing

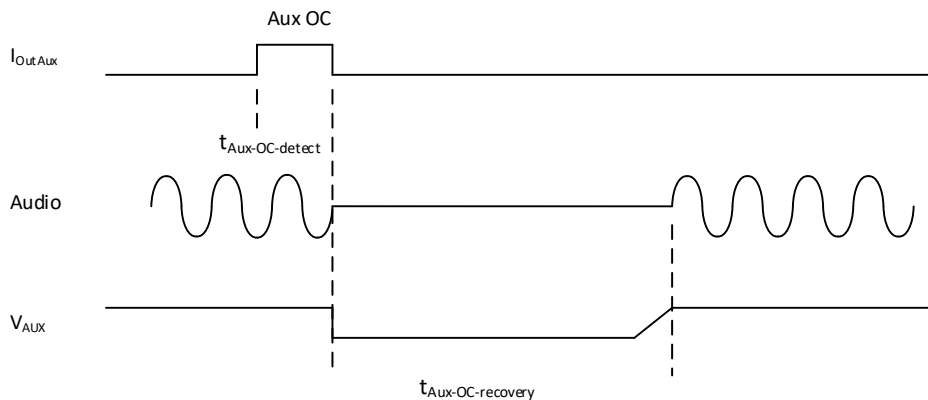


Figure 18: Auxiliary supply overcurrent timing

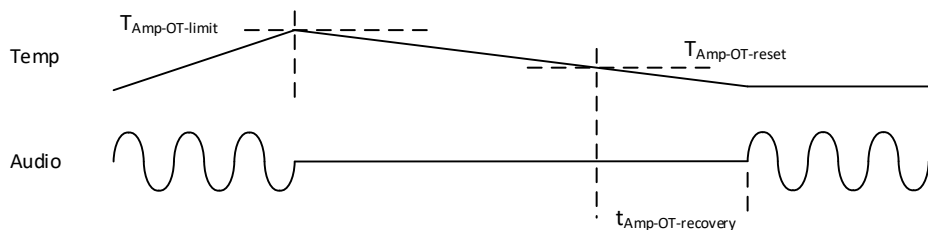


Figure 19: Temperature protection timing



### 10.4.5 DVDD and DVDDstby Power Supply Output

The DVDD and DVDDstby outputs are power supply outputs intended for control circuits on a front-end board e.g. microcontrollers and DSPs.

According to the ICEpower Standard Interface, circuits operating in Standby Mode must be supplied from DVDDstby output whereas the remaining frontend control circuits can be supplied from the DVDD output. Because of the minimalistic design approach in the 200AS1, the 200AS1 has been fitted with only one power supply unit capable of operating in both Standby Mode and in normal operation mode. Therefore, on the 200AS1 module, the DVDDstby and DVDD are connected in parallel. To ensure best possible compatibility with other products following the ICEpower Standard Interface, it is recommended to connect control circuits as intended by the standard.

The DVDD and DVDDstby supply outputs are loosely regulated. They may require additional voltage regulators on a front-end board depending on the type of circuit supplied by these outputs. It is recommended to add extra supply line series feed impedances and decoupling capacitors on the connected PCB to attenuate the power supply voltage ripple. The series impedance can be either a low value resistor or a small inductor. The extra decoupling capacitance must not exceed the value specified in Table 10.

The DVDD and DVDDstby outputs are overcurrent protected. An overload of these outputs will cause all auxiliary power supply outputs including AVDD and AVSS to turn off. After a short delay, the auxiliary output will automatically restart.

Timing of the DVDD and DVDDstby overcurrent event is shown in Figure 18 and specific timing values are available in Section 7.3.

### 10.4.6 AVDD and AVSS Power Supply Output

The AVDD and AVSS outputs are positive and negative power supply outputs intended for analog circuits on a front-end board e.g. analog buffers and speaker crossover filters.

To ensure proper suppression of supply related noise and hum, it is important to have all supply related current draw through the GND connections in the power supply interface. The analog signal ground available in the audio interface connector must not carry any supply related current. For proposed grounding scheme details, please see Section 12.1

The AVDD and AVSS supply outputs are loosely regulated. They may require additional voltage regulators on a front-end board depending on the type of circuit supplied by these outputs. It is therefore recommended to add extra supply line series feed impedances and decoupling capacitors on the connected PCB to attenuate the power supply voltage ripple. The series impedance can be either a low value resistor or a small inductor. The extra decoupling capacitance must not exceed the value specified in Table 10.

The AVDD and AVSS outputs are overcurrent protected. An overload of these outputs will cause all auxiliary power supply outputs including DVDD and DVDDstby to turn off. After a short delay, the auxiliary output will automatically restart.

Timing of the AVDD and AVSS overcurrent event is shown in Figure 18 and specific timing values are available in Section 7.3.

## 10.5 Hanger Rail Supply

To supply an optional amplifier channel on the 200AS1 module, the amplifier positive supply line VD and GND is available in the Hanger Rail Supply connector.

In standby mode, the VD supply line is not shut down. An optional amplifier must therefore include a power down or power off mode if low standby power consumption is required.

**WARNING:** As this VD power output is not over-current protected, a 1.6 A fast acting fuse MUST be included in the supply line on the hanger amplifier PCB. Failing to comply with this requirement is a violation of the ICEpower warranty policy.

# 11 Interface Schematics

In the following sub-sections, proposed interface schematics are shown. These schematics should be considered an assistance to the design process, and they represent the recommended interface to the 200AS1 module.

## 11.1 Audio Input

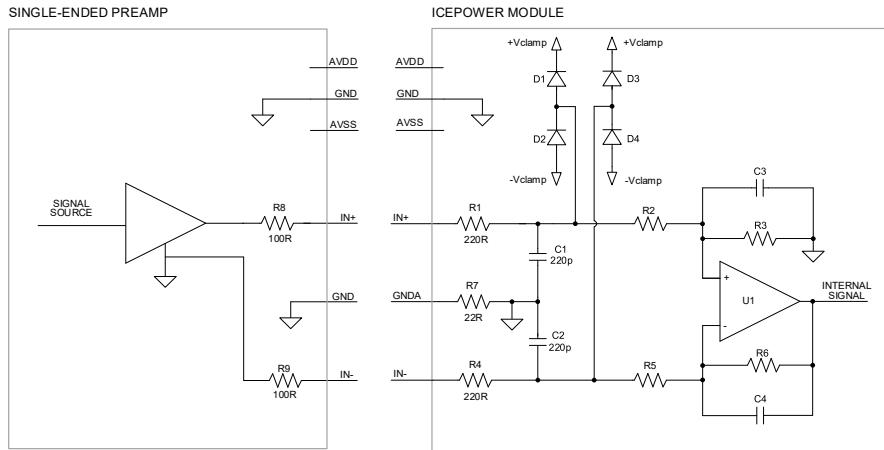


Figure 20: Analog input interface schematics

## 11.2 Control Input

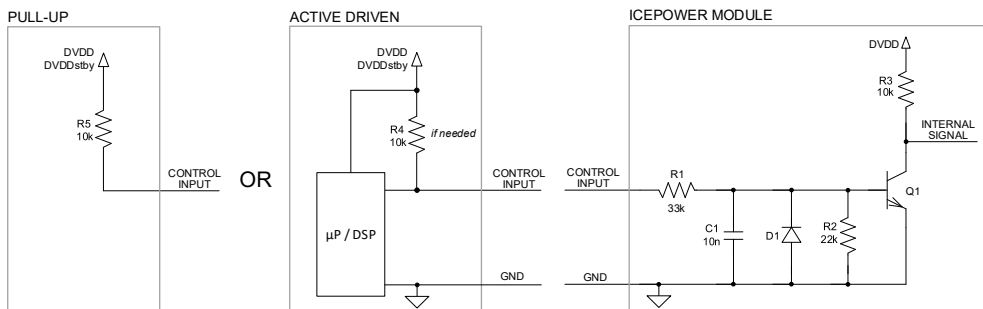


Figure 21: Control input interface schematics

## 11.3 Status Output

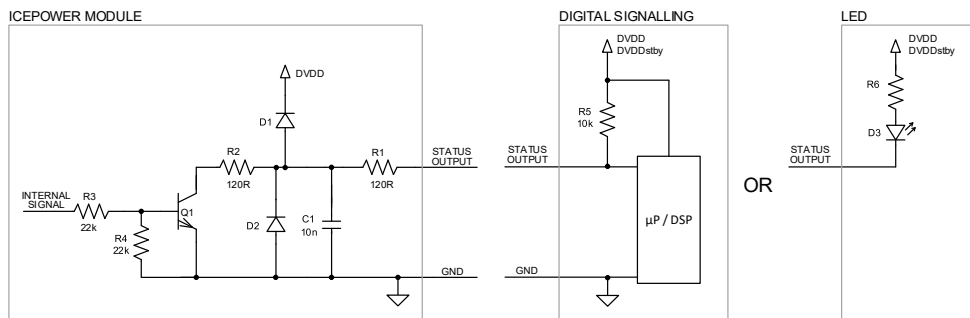


Figure 22: Status output interface schematics

# 12 Integration Guidelines

The 200AS1 module is designed with ease of integration in mind. This includes both electrical, EMC, thermal and mechanical integration. In the following sub-sections, recommendations will be given to assist the end-product design process.

## 12.1 Grounding Scheme

Depending on the complexity of the end-product several grounding schemes can be used. On Figure 23 an example of the grounding scheme usable on the 200AS1 module is shown for a simple setup including a front-end PCB.

The low value series resistor included in the signal shield connection prevents ground loops between the 200AS1 module and the front-end PCB. To prevent similar ground loops between the PCBs and the chassis, it is recommended not to connect the audio input connector to the chassis but to have them grounded on the front-end PCB.

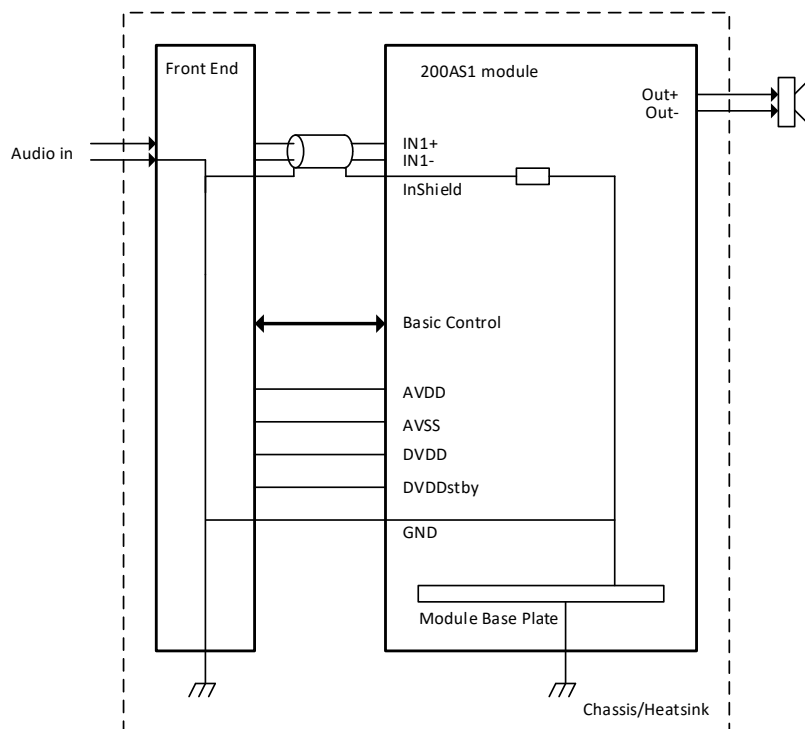


Figure 23: Grounding scheme

## 12.2 EMC Management

As described in Section 1, the ICEpower200AS1 module is EMC pre-approved as is when mounted on a standard aluminum open back plate. However, because of the high-power switching electronics included in the module, some EMC precautions are required to ensure an EMC approvable end-product design.

- Connect the module baseplate to the chassis. Mounting of the module isolated from the chassis may cause extended HF radiation.
- Do not use cable/wires between module and other PCBs that are longer than necessary.
- Avoid wire loops on the speaker output wires. Use wires closely paired side by side or if required use twisted or shielded cables (Figure 24)
- Avoid wire loops on the mains wires from the mains inlet to the module mains connector.
- Do not route cables near by the magnetic components on the module i.e. inductors and transformers.
- Do not bundle mains wires together with other cables (Figure 25).
- Do not bundle speaker wires together with other cables (Figure 25).

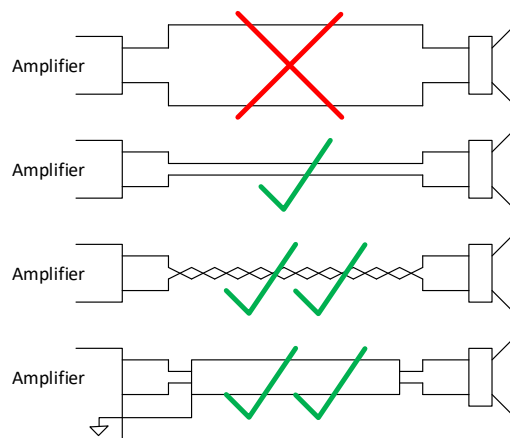


Figure 24: Speaker wire routing

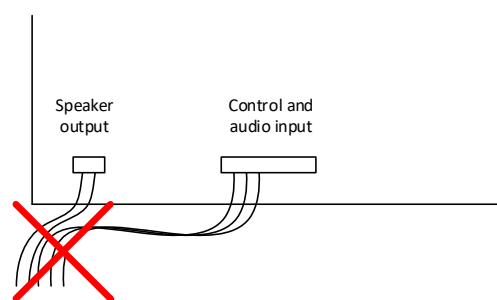


Figure 25: Wire bundling

Depending on the end-product application, additional EMC initiatives and filtering may be required to have the entire product EMC approved. The reason for this could be, among others, insufficient cable routing within the application or DSP/microprocessor based front-end systems.

To improve on EMC performance, it is often advisable to revisit the used grounding scheme and cable routing and add EMC filters on some or all the connector on the end-product.

## 12.3 Thermal Design

The ICEpower200AS1 module is designed with an integrated cooling system in the aluminum base plate. The module can therefore operate without any further cooling however at reduced power levels. Even though use of the module without further cooling is possible, it is recommended to add more cooling.

In most applications, the module will be additionally cooled through the metal chassis or heatsink on which it is mounted. As specified in Section 7, a 2 mm x 200 mm x 300 mm aluminum plate representing a metal chassis has been used as cooling for the power specification in this datasheet.

Besides cooling through the baseplate, it is important to ensure proper airflow around the module. In most cases, this can be achieved through passive convection, but in some cases e.g. 1U rack enclosures, forced airflow may be required depending on end-product mechanical design constraints or end-product use environment.

## 13 Mechanical Mounting

As described in Section 12.3, the ICEpower200AS1 module is designed for mounting in a metal chassis or on a heatsink for added cooling through the aluminum base plate. To give flexibility in the mechanical solutions in different applications, two mountings methods are possible. These are:

- Mounting from the bottom side through six pieces of M3 threaded holes.
- Mounting from the top side through six recesses along the two long sides of the module.

The six circular holes on Figure 3 indicate standoffs with internal M3 threading, used to mount the module PCB to the module base plate. These standoffs have free thread from the bottom side, which can be used for mounting the module. When choosing screws for the mounting, the depth of the threaded holes must be observed as well as the specified mounting torque, both specified in Section 8.1.

Alternatively, the module can be mounted from the top side by use of six recesses in the module PCB and base plate along the edges. Standard 3 mm or 1/8 inch non-countersunk screws are recommended.

When designing the chassis or heatsink solutions for the 200AS1 module, the metal part surface flatness must be controlled to avoid bending or flexing of the module. Additionally, uneven contact surface will result in non-optimal thermal interface.

Finally, thermal conductive compound can be used in the mechanical interface between module and chassis/heatsink if required. Please follow the instructions provide by the thermal compound manufacture as incorrect use can result in non-optimal performance.

# 14 Safety and EMC Standards

The ICEpower200AS1 has been verified to conform to the following standards.

## 14.1 Safety

UL 62368:2014 (Second Edition)

IEC 60065:2014 (Eight Edition) Incl. Compliance with the National requirements of AR, AU, CA, CN, DE, DK, GB, IE, JP, KR, MY, NO, SE, SG, and US.

EN 60065: 2002/A1:2006; EN 60065:2002/A11:2008; EN 60065:2002/A2:2010; EN 60065:2002/A12:2011

CAN/CSA 60065-03 + Am1 + Am2

UL Std No. 60065-03 (2012)

## 14.2 EMC

EN 55032: 2012  
(CISPR 32: 2012)

Electromagnetic compatibility of multimedia equipment – Emission requirements

EN 61000-3-2: 2014  
(IEC 61000-3-2: 2014)

Harmonic current emission

EN 61000-3-3: 2013  
(IEC 61000-3-3: 2013)

Voltage changes, voltage fluctuations and flicker

EN55020: 2007 + A11: 2011  
(CISPR 20: 2006)

Sound and television broadcast receivers and associated equipment – Immunity characteristics – Limits and methods of measurement

EN 61000-4-2: 2009  
(IEC 61000-4-2:2008)

Electrostatic discharge immunity test

EN 61000-4-3: 2006 + A1: 2008 + A2: 2010  
(IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010)

Radiated, radio frequency, electromagnetic field immunity test

EN 61000-4-4: 2004 + A1: 2010  
(IEC 61000-4-4: 2004 + C1: 2006 + C2: 2007 + A1: 2010)

Electrical fast transient / burst immunity test

CFR 47 Part 15 Subpart B (FCC): 2015 Class B

Telecommunication – Radio Frequency Devices – Unintentional Radiation

CFR 47 part 15, subpart B, section 15.107

AC Line conducted emission

CFR 47 part 15, subpart B, section 15.109(a)

Radiated emission, general requirements

## 15 ESD Warning

ICEpower products are manufactured according to the following ESD precautions:

ANSI/ESD-S20.20-2007: Protection of Electrical and Electronic Parts, Assemblies and Equipment.

Further handling of the products should comply with the same standard.

The general warranty policy of ICEpower a/s does not cover ESD damaged products due to improper handling.

## 16 Ordering, Packaging and Storage

All ICEpower modules are packaged in ESD safe bobble bags and cardboard boxes.

### 16.1 Ordering Information

Order Codes	Description	Part Number
ICEpower200AS1	One channel 200 W ICEpower amplifier with integrated universal mains power supply	8008243

### 16.2 Shipping Dimensions and Weight

Package	Quantity	Dimensions (w × d × h) [mm]	Gross Weight [kg]
Carton	20	390 × 290 × 232	7.5

### 16.3 Storage Conditions

Storage Humidity and Temperature:

Please find storage humidity and temperature information in Section 0, Environmental Specifications.

#### Stacking

A maximum of 4 cartons must be stacked on top of each other.

Pallets may not be stacked on top of each other.

## 17 Legal Notes

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- A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## 18 Contact

For additional information about the ICEpower® technology from ICEpower a/s, visit our web site or contact us.

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